THIS IS ONE VOLUME OF A SIX VOLUME SET WHICH INCLUDES:

VOLUME I: FIELD OPERATIONS (FO)
VOLUME II: GROUNDWATER (GW)
VOLUME III: GEOTECHNICAL (GT)
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REVIEWED FOR CLASSIFICATION/UCN
By
Date May 18, 1992

FIELD RADIOLOGICAL MEASUREMENTS

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	Effective Date:	March 1, 1992
Category 2	Organization:	Environmental Management

TITLE:
FIELD RADIOLOGICAL
MEASUREMENTS

Approved: _____ MAY 12 1992
(Name of Approver) / / (Date)

LIST OF FIGURES

2.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) describes procedures and specifies who will conduct those procedures at the Rocky Flats Plant (RFP) to gather radiological data for monitoring environmental materials, samples, and equipment during field activities conducted under the Environmental Management (EM) Program. In particular, this SOP describes monitoring for the presence of radioisotopes. This SOP does not describe procedures for predicting or assessing personnel exposures to radioisotopes.

3.0 RESPONSIBILITIES AND QUALIFICATIONS

Radiological Engineering-approved subcontractor Health and Safety Specialists (HSS) will conduct radiation monitoring activities. All equipment, samples, and personnel will be monitored prior to exiting from the following areas.

- potentially radiologically contaminated areas
- radiological controlled areas designated by the Site Safety Officers (SSO)
- areas that have not been previously characterized by EG&G work area survey and EG&G site characterization

Each subcontractor shall provide an SSO to oversee field monitoring and implement the site-specific Health and Safety Plan. All subcontractor personnel assigned to conduct monitoring activities will have attended either EG&G's 8 hour radiation worker safety course for environmental workers or the three-day radiation worker safety course and will be familiar with the content of this SOP and the applicable manufacturer's instructions for any radiological monitoring instrument that they use.

Subcontractor personnel will conduct radiation monitoring activities within a potentially radiologically contaminated work area to determine the presence or absence of radiological

contamination during field activities. Site-specific monitoring requirements will be identified in the work plan. Monitoring will be performed to identify the requirements for handling of environmental materials.

4.0 REFERENCES

4.1 SOURCE REFERENCES

The following is a list of references reviewed prior to the writing of this procedure:

Nuclear Weapon Accident Response Procedures (NARP) Manual. July 2, 1984. The Defense Nuclear Agency.

Radiological Operating Instruction 3.1. Performance Of Surface Contamination Surveys. August 9, 1989. Rocky Flats Plant Department of Health, Safety, and Environment.

4.2 INTERNAL REFERENCES

Related SOPs cross-referenced by this SOP are as follows:

- SOP FO.3, General Equipment Decontamination
- SOP FO.4, Heavy Equipment Decontamination
- SOP FO.6, Handling of Personal Protective Equipment
- SOP FO.8, Handling of Drilling Fluids and Cuttings
- SOP FO.10, Receiving, Labeling, And Handling Environmental Materials Containers
- SOP GT.2, Drilling and Sampling Using Hollow Stem Auger Techniques

5.0 EQUIPMENT

The following monitoring devices and supplies or equivalent items will be required for each subcontractor to complete the monitoring activities described by this SOP. The EM Health and Safety Officer will determine if a proposed alternate radiation monitoring device is equivalent to those items specified below.

5.1 MONITORING DEVICES

- Ludlum Model 12-1A alpha counter with an air proportional probe
- Ludlum Model 43-10-1 alpha sample counter
- Ludlum Model 2000 scaler/timer
- Bicron Analyst Fidler

5.2 SUPPLIES

- Smear papers sized to fit in the Ludlum Model 43-10-1 alpha sample counter tray
- Plastic bags to contain Ludlum Model 12-1A instrument (excluding the detector probe)
- Heat lamp that is clearly labelled to indicate that it will NOT be used to heat foods or drinks and that it is used to dry potentially radioactive smear test papers
- Replacement probe faces for the Ludlum Model 12-1A
- Swipe material such as Kimwipes
- Fold-over envelopes or Glassine envelopes
- Stainless steel scoop

6.0 PROCEDURES

6.1 WORK AREA CHARACTERIZATIONS

Each project area will be characterized by EG&G prior to any field activity. Work area characterizations will be based on the historical background of the work area, EG&G Historical Release Reports and the results of field radiological surveys conducted by Radiological Engineering-approved subcontractor Health and Safety Specialists. Work areas associated with the EM program field operations fall into two characterizations: potentially contaminated and not potentially contaminated. Work areas currently characterized as potentially contaminated include the following:

- Individual Hazardous Substance Sites (IHSS)
- Identified Groundwater Plume Areas
- Americium Zone at OU No. 2
- Protected Areas (PA).

See SOP FO.10, Receiving, Labeling, and Handling of Environmental Materials Containers, for specific work areas currently characterized as potentially contaminated. All other potentially contaminated work areas will be specified in the individual project work plans and/or health and safety plans.

6.2 MONITORING TECHNIQUES AND TASKS

6.2.1 Monitoring Techniques

Radiological Engineering-approved subcontractor Health and Safety Specialists will follow the procedures and apply the contamination limits established for alpha contamination by

Environmental Management Radiological Guidelines 3.0, Environmental Performance of Surface Contamination Surveys, found in manual EMD3-21000 OPS EMRG Tables I and II.

At a minimum, disposable protective gloves will be worn when screening procedures are conducted. When the Ludlum Model 12-1A is being used, it will be placed in a plastic bag, with the exception of the probe, to prevent contamination of the instrument.

The following subsections describe the field monitoring techniques that will be accomplished by the HSS. It is important that the following monitoring techniques be thoroughly understood before the monitoring tasks descriptions provided in Subsection 6.3.2 are reviewed.

6.2.1.1 Monitoring With A Ludlum Model 12-1A

Monitoring with a Ludlum Model 12-1A will normally be done at the work area. It should be noted that alpha radiation will not penetrate the upper layer of a wet surface nor will it travel farther than approximately an inch in air. Therefore, the Ludlum Model 12-1A cannot be used to screen wet surfaces and must be held parallel to and within one quarter inch of the surface being screened.

The Ludlum Model 12-1A count rate meter with an air proportional probe will be used as described in this subsection to monitor environmental materials, samples, equipment, and personnel. Direct surface monitoring with a Ludlum Model 12-1A is a relatively speedy method of determining the presence and extent of potential radiological contamination. However, this method will not distinguish between fixed and removable radiological contamination.

The preferable method of using a Ludlum Model 12-1A to monitor for surface contamination is to make sequential overlapping measurements with a stationary probe. However, slowly sweeping the probe over the surface will also produce accurate results if the Ludlum probe is not moved faster

than 2 inches per second over the surface being screened and the probe is stopped and held stationary over any indicated counts per minute (cpm) value.

Monitoring results greater than 300 disintegrations per minute (dpm)/100cm^2 as indicated by the Ludlum Model 12-1A will be considered indicative of the presence of radiological contamination on the surface. Decontamination procedures are in the SOPs listed in Subsection 4.2.

6.2.1.2 Monitoring With A Large Area Swipe

Monitoring with large area swipes will normally be accomplished at the work area. Large area swipes are used to detect removable surface radiological contamination. Swipes will be performed by firmly wiping an area greater than 100 square centimeters (cm^2) but not exceeding 1 square meter with a soft absorbent material (i.e., Kimwipes). The monitoring will be completed by using a Ludlum Model 12-1A to monitor that area of the swipe material that contacted the potentially contaminated surface. The swipe being monitored should be relatively flat as it is being screened.

Monitoring results greater than 300 dpm/100cm^2 from a large area swipe as indicated by monitoring with a Ludlum Model 12-1A will be considered indicative of the presence of radiological contamination and will necessitate locating the contamination on the surface being monitored by the large area swipe. The contamination will be located by monitoring the surface with a Ludlum Model 12-1A as described in Subsection 6.3.1.1. Decontamination procedures for various items are contained in the SOPs listed in Subsection 4.2.

Environmental materials found to have an activity greater than 300 dpm/100m^2 as indicated by the Ludlum Model 12-1A will be treated as low-level radioactively contaminated environmental materials. Swipes found to have an activity less than 300 dpm/100m^2 will be handled as uncontaminated environmental materials.

6.2.1.3 Monitoring With A Small Area Smear

Monitoring small areas with smear paper and counting the smears in the Ludlum Model 43-10-1 alpha sample counter is the accepted monitoring technique for HSS use. Whenever radioactive contamination is detected during the monitoring tasks described in Subsection 6.2.2, small area smears will be done to verify removal of that contamination. Small area smears may be taken from wet surfaces provided that the smears are dried before being counted. A heat lamp may be used to speed the drying process prior to counting.

Use caution when smearing rough surfaces so as not to abrade or tear the smear paper. Damaged smear paper might not provide a representative level of the contamination present. Prior to use, a small "X" will be made with a pencil on the face of the small area smear paper that will contact the surface being monitored. Hold the smear paper between the thumb and fingers, with the back of the smear against the fingers. Place the face of the smear paper against the surface to be smeared. Apply moderate pressure across the smear to ensure that at least one half of the face of the smear comes in contact with the surface being surveyed. Wipe (smear) an area of approximately 100 cm^2 (approximately a 4 inch by 4 inch square). Rotate the smear paper one-half turn and smear the same area again. All smear papers will be handled carefully to avoid cross-contamination and will be identified as to the location/surface smeared, placed in a glassine envelope, and transferred to the Ludlum Model 43-10-1 alpha sample counter for counting after the smear paper is removed from the fold-over envelope or glassine envelope.

Small area smears that indicate an activity level of greater than 20 disintegration per minute (dpm) as measured with a Ludlum Model 43-10-1 alpha sample counter and Ludlum Model 2000 scaler/timer will be considered as indicative of potential radioactive contamination. Decontamination procedures are contained in the SOPs listed in Subsection 4.2.

Small area smear papers will be treated as low-level radioactively contaminated environmental materials.

6.2.2 Monitoring Tasks

Radiological Engineering-approved subcontractor Health and Safety Specialists will monitor environmental materials containers, sample containers, equipment, and personnel exiting potentially contaminated work areas and work areas characterized as not potentially contaminated if monitoring by subcontractors indicates the potential presence of radiation contamination above background. Radiological Engineering-approved subcontractor Health and Safety Specialists will also conduct prework area monitoring of potentially contaminated work sites. Prework area monitoring will be scheduled with a Radiological Engineering-approved subcontractor Health and Safety Specialist as far in advance as possible. A minimum notice of one workday is required.

6.2.2.1 Work Areas

Work area monitoring will be accomplished (prior to work starting) to indicate if surficial radioactivity exists in the immediate work area. Prework area monitoring will be accomplished by making direct soil surface measurements with a Bicron Analyst Fidler (or equivalent instrument). A minimum of 17 measurement points will be used for a prework area survey. A grid of the measurement points that is centered on the point of the intrusive activity is depicted in Figure FO.16-1. A measurement of 250 cpm or less as measured by a Bicron Analyst Fidler (or equivalent instrument) indicates only background levels of radioactivity are present. At surface sediment sampling sites a single monitoring with a Bicron Analyst Fidler (or equivalent instrument) at the sampling point will constitute prework area monitoring. Documentation of area monitoring will be accomplished by completing Section I of Form FO.16A, Results of Radiological Measurements In The Field.

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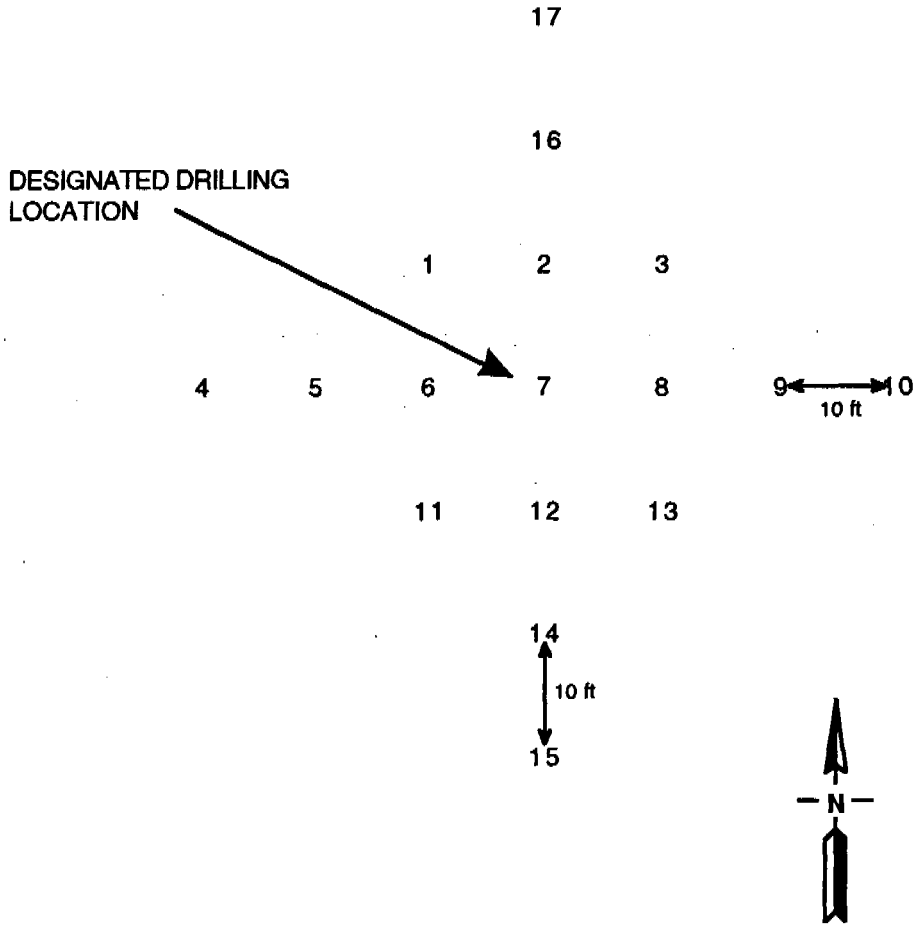
MINIMUM MEASUREMENT POINTS FOR A PREWORK RADIATION SURVEY (# = Measurement Point)



At the designated drilling location, the Ludlum 12-1A will be used for a single measurement as described in SOP GT.2, Drilling and Sampling Using Hollow Stem Auger Techniques. Areas with measurements greater than 300 dpm/100cm^2, but less than 3000 dpm/100cm^2 will be classified as Controlled Areas. Areas with measurements greater than 3000 dpm/100cm^2 will be classified as Radiological Controlled Areas. For measurements above 300 dpm/100cm^2 additional guidance can be found in manual EMD-3-21000 OPS, EMRG 1.3, Posting of Radiation Protection Requirements.

6.2.2.2 Environmental Materials

6.2.2.2.1 Drilling Cuttings. During soil boring and well construction, the point of intrusive activity will be monitored with the Bicron Analyst Fidler and/or a Ludlum 12-1A (or equivalent instruments) before the auger bit is set on the ground.

Normally, as the auger starts rotating, the soil cuttings will be wetted as they are generated, and the wetting process will preclude monitoring of the soil cuttings with a Ludlum Model 12-1A. However, each time the auger is stopped for the addition of another auger flight, the accumulated core or wetted soil cuttings will be monitored. If drilling cores are not samples, as the augers begin rotating again, a small (approximately 1 cup) sample will be collected from the dry soil cuttings brought to the surface before the wetting process begins. The sample of dry soil cuttings will be spread evenly over a surface known (by prior monitoring) to be free of radiological contamination and monitored with the Bicron Analyst Fidler and/or the Ludlum Model 12-1A. Drilling cutting's monitoring results will be recorded on Form FO.8A, Field Monitoring Results of cuttings and core, as described in SOP FO.8, Handling of Drilling Fluids and Cuttings.

If the soil cuttings being generated are wet as they appear at the ground surface, monitoring those cuttings with a Ludlum Model 12-1A will not produce useful data.

Therefore, either the Bicron Analyst Fidler or small area smears from the interior of the split-spoon sampler will be used.

6.2.2.2.2 Environmental Materials Containers. Sealed environmental materials containers will be monitored in the work area if the work area was characterized as potentially radiologically contaminated by EG&G site characterization. Sealed environmental materials containers used in an area characterized by an HSS as uncontaminated will also be monitored in the work area if the potential presence of radioactive contamination was indicated during any of the monitoring tasks conducted as field work progressed.

If the environmental materials containers are dry, the top and side will be monitored with a Ludlum Model 12-1A. When monitoring the sides, the long axis of the Ludlum probe will be held parallel to the long axis of the environmental materials container. If the environmental materials container is wet, the top and sides will be monitored with small area smears.

After decontamination at the main decontamination facility, sealed environmental materials containers will be monitored with small area smears if the containers were found to be radioactively contaminated during monitoring tasks completed in the field. Four small area smears will be conducted around the side of the top one-third of each drum. The four small area smears will be spaced around the drum so that each individual small area smear is approximately 90° around the drum from the nearest adjoining small area smear site. Documentation of environmental materials container monitoring will be accomplished by completing Section II of Form FO.16A, Results of Radiological Measurements In The Field.

6.2.2.3 Samples

Drilling cores that are dry will be monitored with the Ludlum Model 12-1A after the split-spoon sampler is opened. If the drilling core is wet, a small area smear will be conducted on the interior side of the empty half of the split-spoon sampler. The results of each core monitoring will be assigned to the core number that represents the core screened. Any radiological measurement of the core sample greater than background will be documented on Form FO.16A, Results of Radiological Measurements in the Field. The measurement will be validated and the final results noted. The final result will also be documented on Form FO.8A, Field monitoring Results of Cuttings or Core.

In potentially radiologically contaminated work areas and in not contaminated areas where field radiological monitoring conducted during intrusive activities (see SOP FO.8, Handling of Drilling Fluids And Cuttings) revealed the potential for radioactive contamination, a small area smear of the exterior of the sample container will be taken. The small area smear counting results will be used to verify decontamination of the sample container. Documentation of sample monitoring will be accomplished by completing Section III of Form FO.16A, Results of Radiological Measurements In The Field.

Core intervals obtained from within known IHSSs, the Americium Zone, Identified Groundwater Plume areas, Protected Areas, and in areas where surface contamination has been detected, will be monitored and the results recorded. If the space provided is insufficient to record all the monitoring results, additional core monitoring results will be recorded on the reverse side of the form, and an annotation made on the front of the form regarding the location of additional results.

6.2.2.3.1 Monitoring in Bedrock

The following requirements will apply during bedrock drilling when the alluvium has been isolated from bedrock at sites in non-IHSS areas when all these conditions apply:

- there has been no historical radiological contamination
- surface radiological contamination was not detected during the pre-work site survey
- no radiological contamination was detected while drilling in the alluvium

When the alluvium has been isolated from the bedrock as per SOP GT.3, Isolating Bedrock from Alluvium with Grouted Surface Casing, the exclusion zone will be kept for safety and site control purposes only. Egress from the area will be allowed without field decontamination and radiological screening of personnel or equipment. Swipe sampling will be performed on the interior of each core barrel to properly determine core handling procedures.

If radiological contamination was encountered during monitoring of the alluvial core or cuttings, these materials will be handled as per sections 6.2.2.2.1 and 6.2.2.3. Periodic swipe samples will be taken of downhole equipment as a control measure. Periodic screens of personnel will be conducted at a minimum of twice daily and an end-of-day personnel frisk will be performed to insure that if any contamination is present, it does not leave the site via workers.

6.2.2.4 Equipment

6.2.2.4.1 Heavy Equipment. Heavy equipment will be monitored in the field if the heavy equipment was used in an area characterized as potentially radiologically contaminated or in an area characterized as not potentially contaminated where monitoring tasks indicated the potential presence of radiological contamination. Surfaces that have been in direct contact

with soil will be monitored with a Ludlum Model 12-1A after contamination-reduction activities have been accomplished as described in SOP FO.4, Heavy Equipment Decontamination. Special attention will be paid to the tires/tracks, augers, etc.

Heavy equipment found to be radioactively contaminated in the field will undergo contamination reduction activities in the field. If contamination cannot be removed the heavy equipment will be brought in a trailer to the decontamination facility and decontaminated. After decontamination, the equipment will be monitored with small area smears to verify the decontamination process. The small area smears will be accomplished regardless of the results of field monitoring after contamination reduction activities in the field.

Documentation of all heavy equipment monitoring will be accomplished as described in SOP FO.4, Heavy Equipment Decontamination.

6.2.2.4.2 General Equipment. General equipment that has been in direct contact with soil will be screened with a Ludlum Model 12-1A. Large area swipes will be conducted on non-uniform objects and/or surfaces (such as odd shapes, inside surfaces, small items, etc.).

General equipment found to be radioactively contaminated in the field will be monitored by small area smears after final decontamination to verify the decontamination process. The small area smears will be accomplished regardless of the results of field monitoring after decontamination activities in the field.

Documentation of all general equipment monitoring will be accomplished as described in SOP FO.3, General Equipment Decontamination.

6.2.2.4.3 Heat Lamps. Heat lamps may be used prior to counting to dry smears that have been wetted during field activities.

7.0 DOCUMENTATION

Documentation will be maintained by the SSO concerning the results of radiological monitoring specified in this SOP. Form FO.16A, Results of Radiological Monitoring In The Field, will be used to record the required information. Form FO.8A, Field Monitoring Results of Cuttings or Core is provided to assist in the documentation of the drilling core sampling. As described in Subsection 6.2.2.3, Form FO.16A will be used, if any initial radiological measurement is greater than background. The validation results will be noted. The final validation results will be documented on Form FO.8A, as well.

RESULTS OF RADIOLOGICAL MEASUREMENTS IN THE FIELD

Project Name: _____

Date: _____ Site Number: _____

Snow Cover Present (Y/N): _____ Work Surface Wet (Y/N): _____

1. Instruments Used and Background Readings

Manufacturer and Model No.	Serial Number	Probe Type	Probe Serial No.	Calibration Due Date	Background Reading (cpm)

2. Prework Monitoring Results (Ludlum 12)

_____ cpm at Point of Intrusive Activity _____ Highest Measured cpm

3. Sample Monitoring: Intervals Monitored and Associated Samples

Depth Interval (Ft)	Highest Level Noted (cpm)	Associated Sample Numbers

Completed By: _____
Print Name Signature Date

Subcontractor: _____

RESULTS OF RADIOLOGICAL MEASUREMENTS IN THE FIELD

Project Name: _____

Date: _____ Site Number: _____

Snow Cover Present (Y/N): _____

1. Instruments Used and Background Readings

Manufacturer and Model No.	Serial Number	Probe Type	Probe Serial No.	Calibration Due Date	Background Reading (cpm)

2. PPE Monitoring

_____ PPE monitoring not required. Work area was characterized as uncontaminated and field radiological screening as work progressed did not indicate the presence of potential contamination.

If PPE monitoring required complete the following table

Ludlum Model 12	Bicron Analyst Fidler	PPE screening resulted in verived positive reading (Y/N)	Time	PPE Verified positive reading (cmp)	Smear No.

Completed By: _____
Print Name Signature Date

Subcontractor: _____